

# US Army Research Laboratory

*Weapons and Materials Research Directorate*

## ***Coatings Developments for Vehicles Way Forward***

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Courtesy of U.S DoD

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

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- ***Who we are & What we do.....***
- ***Prior History and Evolution of CARC***
- ***Considerations for the future***
- ***Coatings Systems for Land Vehicles***
- ***GAPS to address and Considerations for Coatings Advancement***



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- ARL is the Lead DOD R&D Activity for CARC
    - Innovative formulations approaches
    - New raw materials selections
    - Advanced characterization
  - Maintains Ownership for all key specifications regarding pretreatments, primers and topcoats for all tactical and related support equipment and munition coatings.
- ❖ *Elements above assist to implement and transition products*

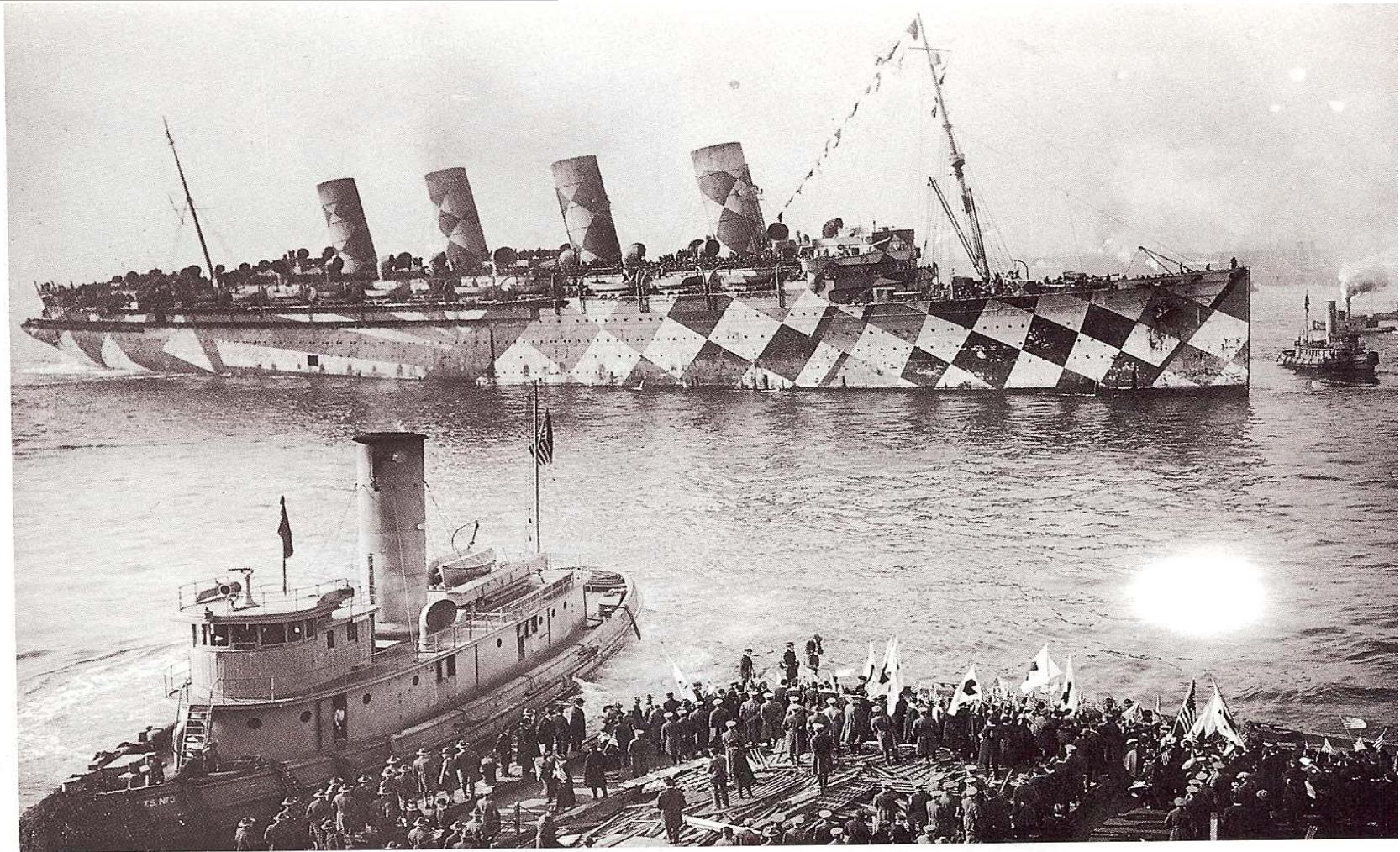
## Environmental

## Survivability



## Durability

# Good Intent .....



During World War I, the British passenger liner Mauretania was painted in a camouflage scheme reminiscent of Picasso's Harlequin. Thayer, who advocated painting ships white, likely viewed the project as a misapplication of his theory of disruptive coloration.

Smithsonian Magazine , April 1999

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- ❖ Recent Coatings represent superior durability, environmental compliance
- ❖ Stereotypes associated with Emulsions, Water Based or Hexavalent Chromium Free chemistries no longer hold true.
- ❖ Current efforts establishes solid foundation for present and future survivability enhancements and multifunctional capabilities
- ❖ Services are moving rapidly to eliminate standard coatings used and are implementing a new generation of coating technology throughout DOD

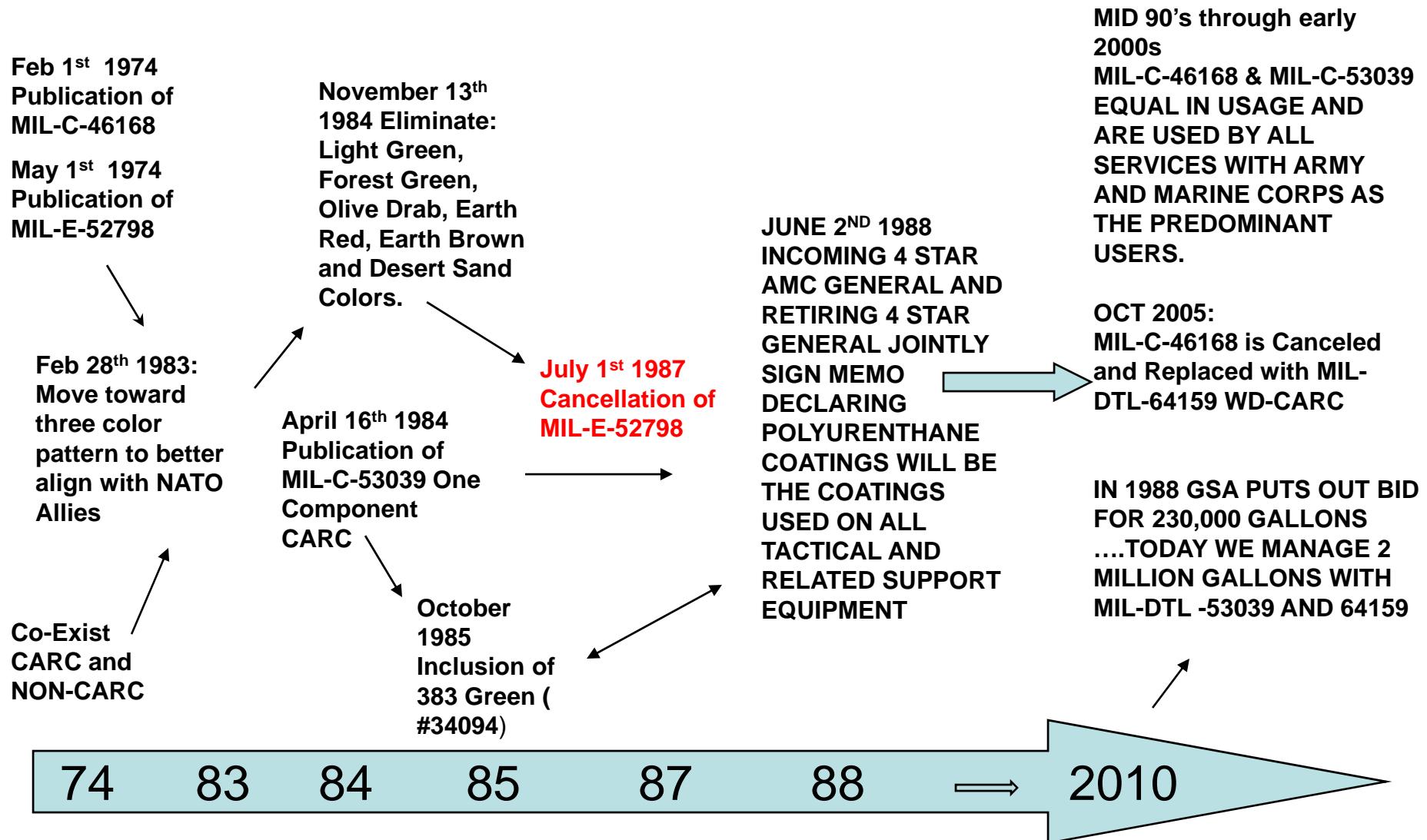
- 20-25 years ago Army- Marine Corps Coating systems well defined.
- DoD had sufficient outdoor exposure history and submissions were similar to one another.
- It was appropriate to use neutral salt fog for QC validation.
- Since we had field history and correlation were in hand, confidence was high if lab test were satisfactory outdoor life cycle would be predictable .
- Today this is no longer the case

- Today this is no longer the case.....
- We have numerous mandates, existing laws and guidelines that require novel and unique chemistries
- Multiple substrates to contend with and a larger selection of topcoats, primers and pretreatments that when evaluated as a “system” mitigate and prevent corrosion and degradation in different ways.
- HENCE AS A COMMUNITY WE CANNOT DO AS WE ARE DOING

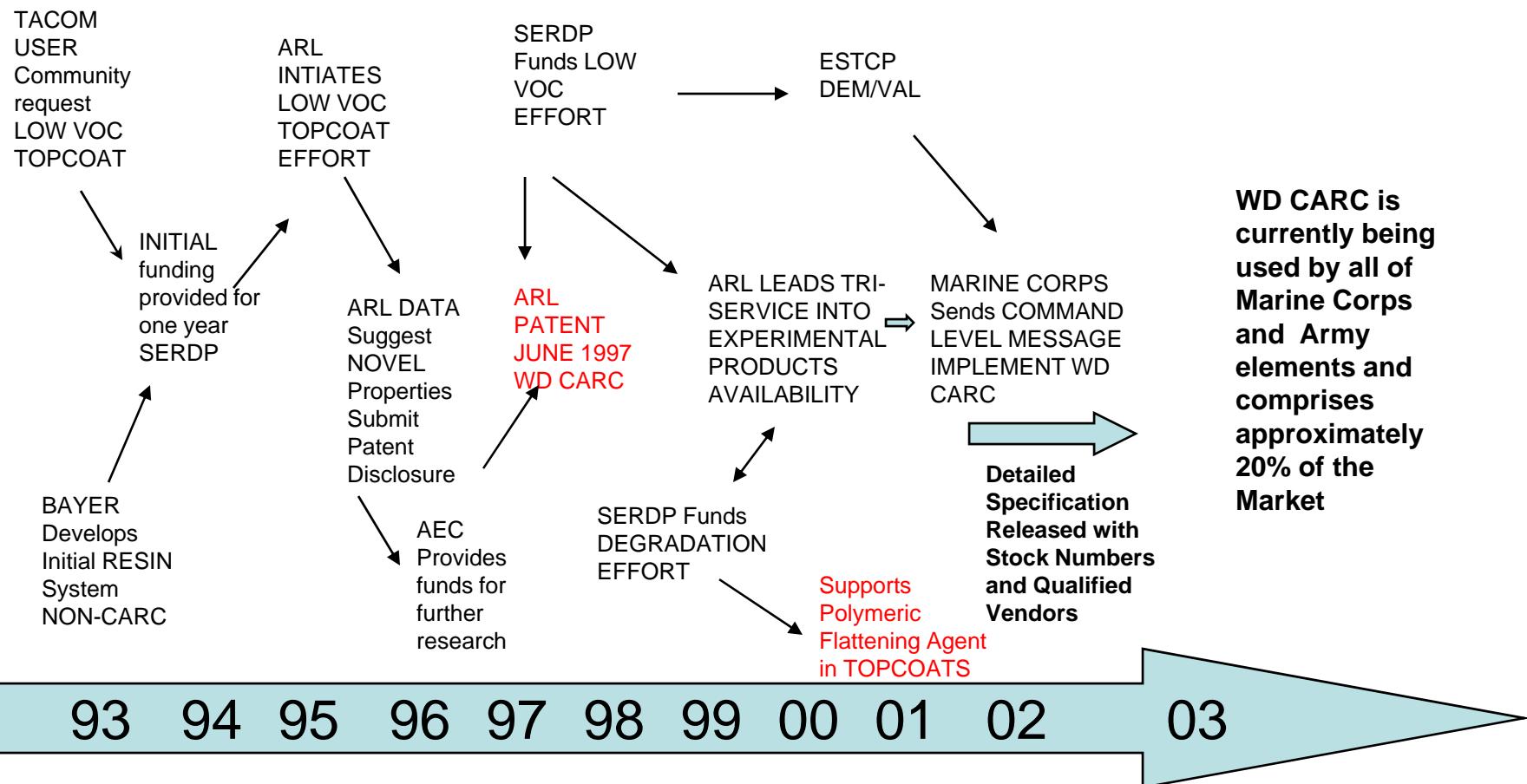
- HENCE AS A COMMUNITY WE CANNOT DO AS WE ARE DOING:
- MAKE ASSUMPTIONS THAT ALL CORROSION INHIBITORS WILL RESPOND OR ACT SIMILAR IN ANY ACCELERATED CHAMBER EVALUATION
- X HOURS IN TESTING PROVIDES CONFIDENCE
- SERVICES RESPONSIBLE FOR VALIDATION NOT KNOWING THE COMPOSITION OF MATERIALS USED
- THINKING THAT AN “ADVANCE ACCELERATED PROTOCOL” WILL BE THE ANSWER FOR QUICKER OR MORE EXPEDIENT DATA

- THINKING THAT AN “ADVANCE ACCELERATED PROTOCOL” WILL BE THE ANSWER FOR QUICKER OR MORE EXPEDIENT DATA .....
- UNLESS WE KNOW THE CHEMISTRIES AND CAN CONFIRM SIMILAR DEGRADATION MECHANISMS IN OUTDOOR EXPOSURE AND CHAMBERS IT IS A FAÇADE TO BELIEVE X HOURS IS PREDICTIVE OF X TIME OUTDOORS.

# 36 YEAR TIME LINE OF CARC



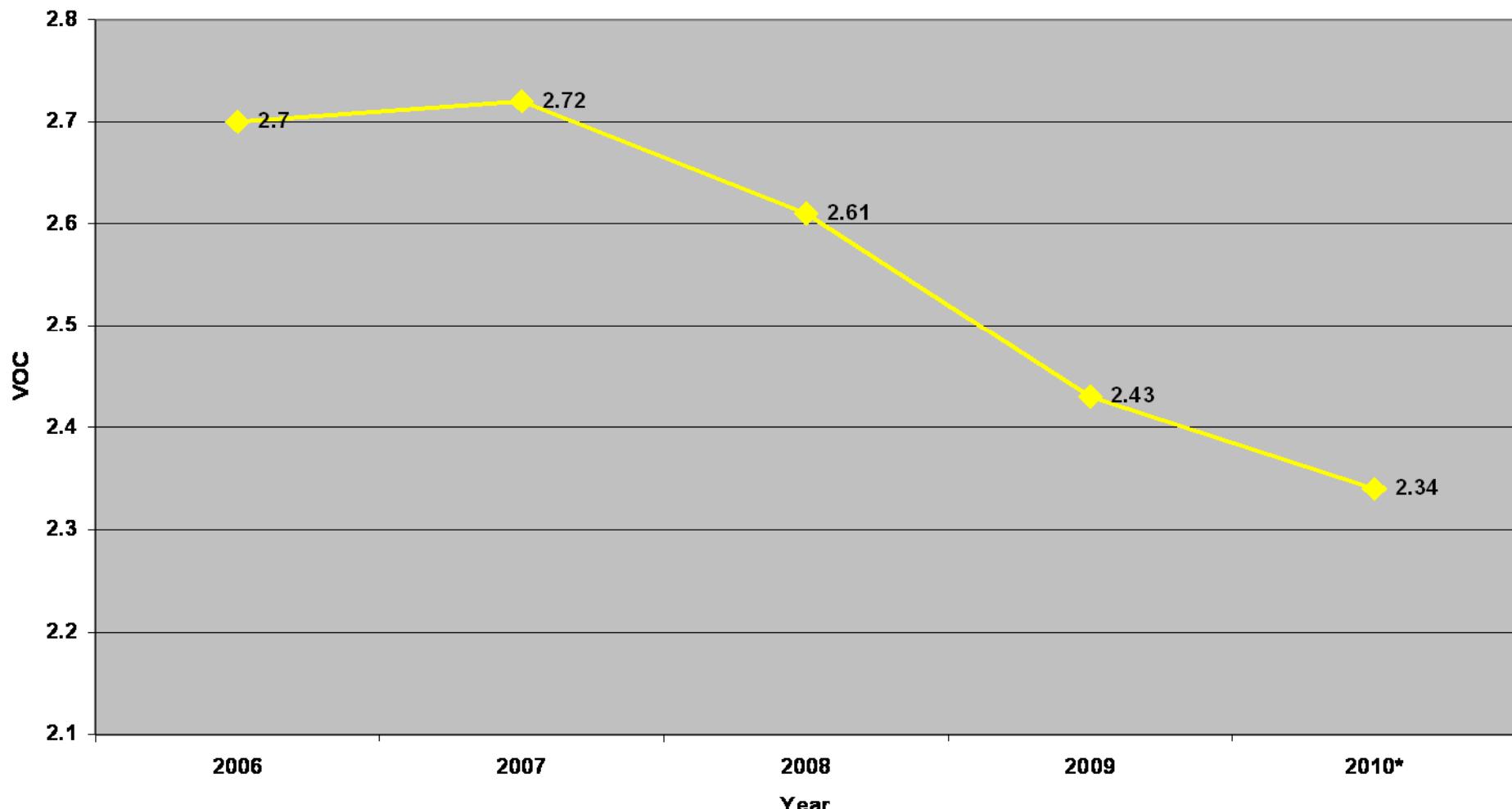
## Details: Water Dispersible CARC



- Chemical Agent Resistant Coatings (CARC) is mandated by AR-750-1 for all tactical equipment.
- Every initial submission is fully tested and validated for Qualified Listing.
- Each batch from the initial submission is tested for color, gloss, IR and decontamination resistance. Included in the batch submission is batch volume. Next slide total volumes\*
- Volume of coatings usage by Army is enormous: Several million gallons costing several hundred of millions of dollars annually will be reduced as developments are implemented and durability is improved.

# Average VOC (lb/gal) CARC Topcoat

**Average VOC per Gallon  
Topcoat**

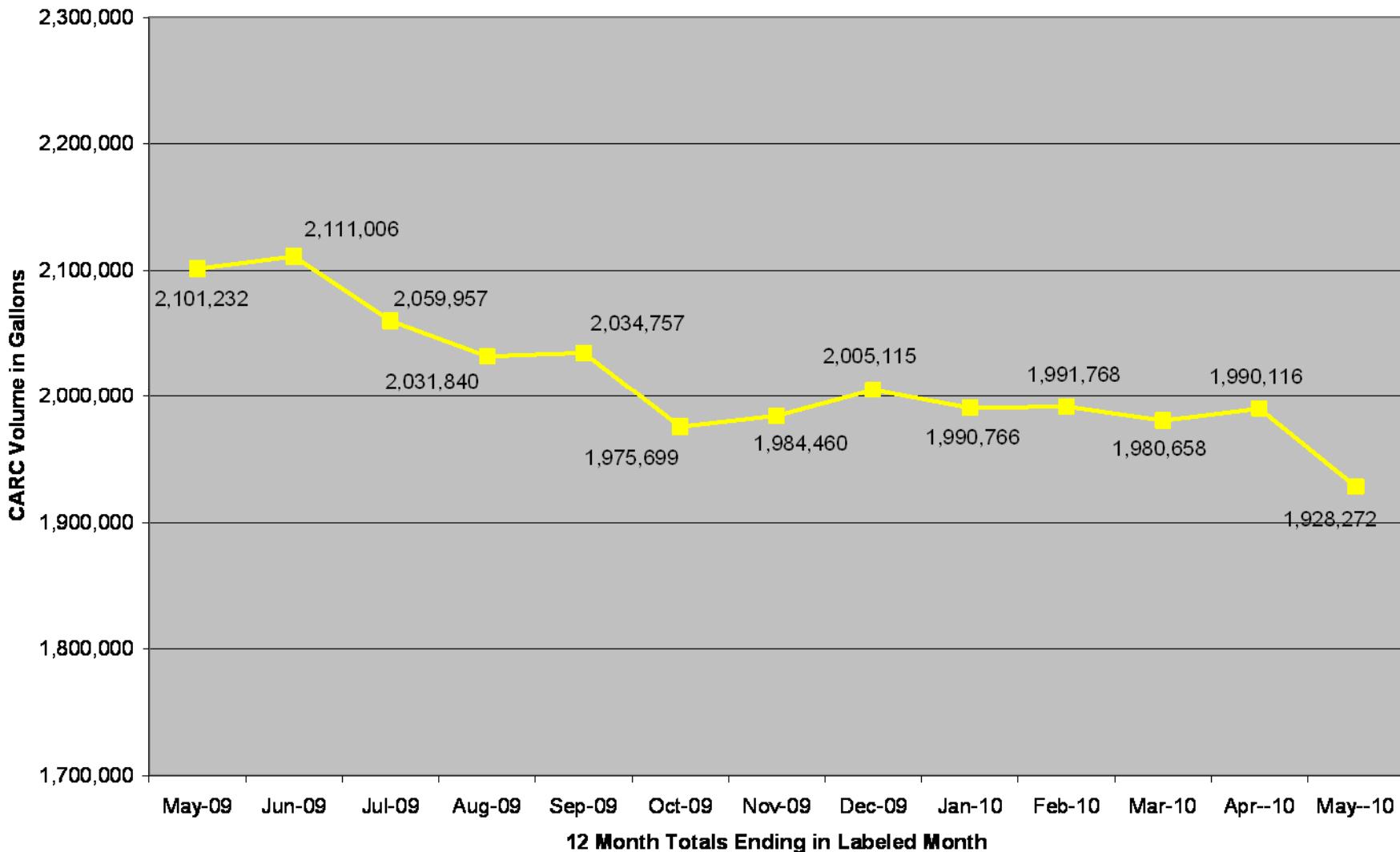


\*January to May

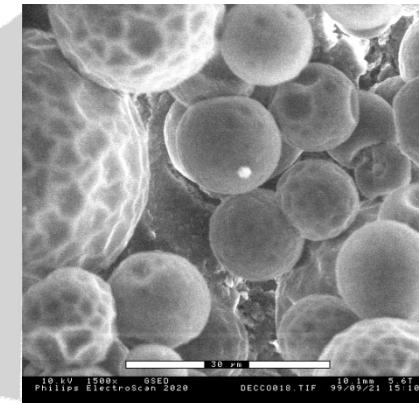
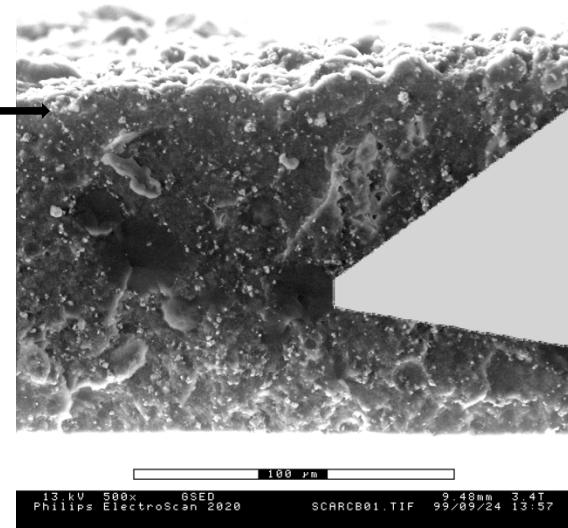
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# CARC Batch Volume

## May 2009 – May 2010

**CARC Batch Volume**

Polymeric beads →  
Army will  
Discontinue use  
of Silica based  
topcoats



- Integrated within Film

- **Polymeric beads**
  - Reduce chalking effect
  - Improve UV resistance
  - Improve performance



Diatomaceous silica

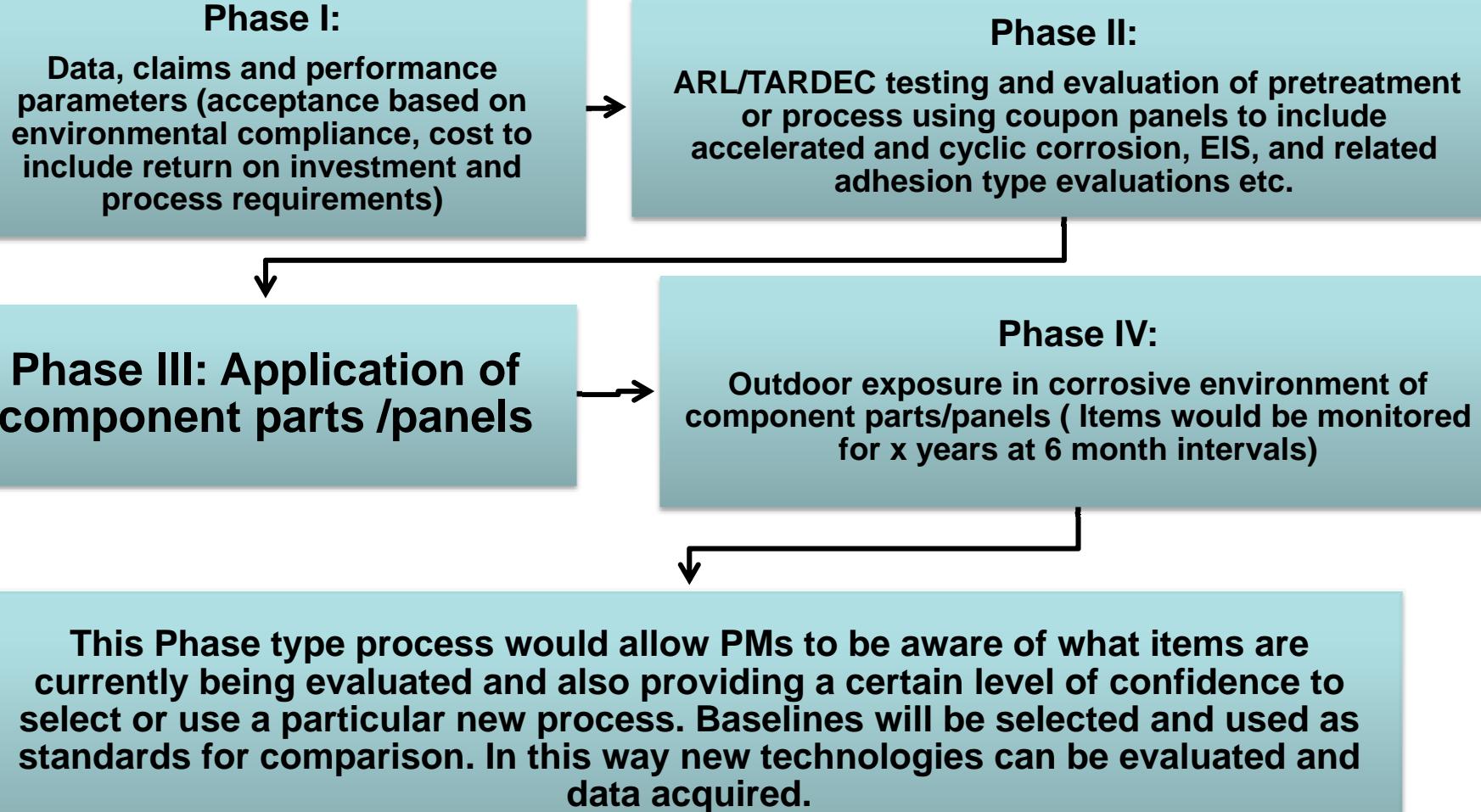
Talc

- Letter has been issued:  
**Key Points**
- No longer accepting silica based coatings
- November 1<sup>st</sup> 2010 discontinue batch validation
- Deplete inventories until consumed

- New type to include Enhanced Corrosion Resistance and require cyclic corrosion evaluation.
- 1000Hrs Neutral Salt Fog
  - ASTM D610 RATING OF 9
  - ASTM D1654 RATING OF NOT LESS THAN 6 FOR STEEL
  - ASTM D1654 RATING OF NOT LESS THAN 8 FOR AL.
- 40 Cycles
  - ASTM D1654 RATING OF NOT LESS THAN 7 FOR STEEL & AL.
- Open to novel corrosion inhibitors
- Allowing vendors to provide exempt solvent package and provide a universal exempt solvent
- Similar effort to occur for 53022

- MIL-DTL-53084 and Powder to include the color Black.
- Open to novel corrosion inhibitors
- Powder Specification to include both Primer and Topcoat within same document
- Coordination Date 8/10

- The key hurdle is acquiring long term outdoor exposure data for platforms making current and near future decisions.
- Confidence that our accelerated screening processes are relevant to long term exposure results.
- Ensuring pretreatment and coating processes are followed accurately to enhance corrosion resistance and provide adequate adhesion/compatibility for subsequent coatings.



# Increased Options for Balanced Requirements

